

Environmental Protection Department *Operations & Regulatory Affairs Division*

LLNL Experimental Test Site 300

Compliance Monitoring Program for RCRA-Closed Landfills Pits 1 and 7 and Process Water Surface Impoundments

Second Quarter Report April-June 1995

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Introduction

This report presents results of work performed from April 1 through June 30, 1995, as part of Lawrence Livermore National Laboratory's (LLNL) Site 300 Compliance Water Monitoring Program. Site 300, the LLNL Experimental Test Site, is located in the Altamont Hills approximately 15 kilometers (9 miles) southwest of the city of Tracy. This report fulfills requirements set forth in the following:

- 1. The California Department of Health Services (DHS)-approved LLNL Site 300 Resource Conservation & Recovery Act (RCRA) Closure and Post-Closure Plans (PCP) for Landfill Pits 1 & 7 (Rogers/Pacific Corp., 1990), currently administered under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Federal Facility Agreement (FFA) with oversight by the U.S. Environmental Protection Agency (U.S. EPA, Region 9), the California Environmental Protection Agency (CAL/EPA) Department of Toxic Substances Control (DTSC), and the California Central Valley Regional Water Quality Control Board (CVRWQCB);
- 2. Waste Discharge Requirements (WDR) Order 85-188, administered by the Central Valley Regional Water Quality Control Board (CVRWQCB, 1985); and
- **3**. Waste Discharge Requirements (WDR) Order 93-100, administered by the Central Valley Regional Water Quality Control Board (CVRWQCB, 1993).

This report covers three areas within Site 300 as described in WDR 93-100 (Pit 1 and Pit 7 Complex Areas) and WDR 85-188 (High Explosives [HE] Area process-water surface impoundments). **Figure 1** is a map of Site 300 showing the three areas covered by this report.

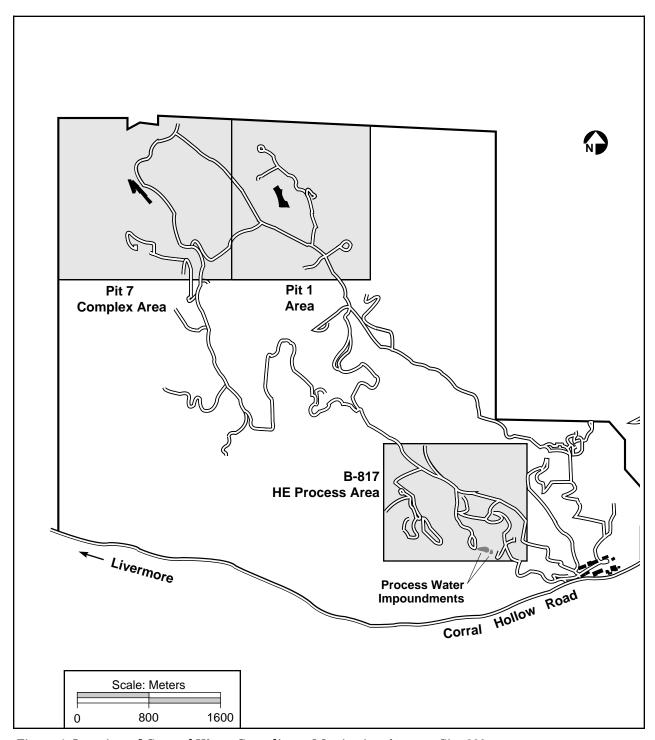


Figure 1. Location of Ground Water Compliance Monitoring Areas at Site 300

Compliance Ground Water Monitoring Program

The wells that comprise the three ground water compliance monitoring networks are specified in the monitoring plans that accompany WDR 85-188 and WDR 93-100. During the second quarter 1995, ground water samples from these wells were analyzed for constituents called for in the monitoring plans. Within the Pit 1 Area, ground water samples from eight monitoring wells were analyzed. Within the Pit 7 Complex, ground water samples from nine monitoring wells were analyzed. In the HE Process Area, ground water samples from five monitoring wells were analyzed, and the leachate collection systems and lysimeters installed beneath the process-water impoundments were checked for the presence of water.

Analytical results for the second quarter that indicate potential release of constituents of concern to the ground water, or exceed any Federal or California state Maximum Contaminant Level (MCL), are listed in the following "Summary of Results" section of this report and are discussed in the "Discussion of Monitoring Results" section. **Appendix A** contains tables of analytical data obtained from measurements of ground water samples during the second quarter of 1995. **Appendix B** contains a discussion of the statistical methods used to test for evidence of releases of chemicals to the ground water. It also contains tables giving the results of statistical analyses performed on the second quarter ground water data. **Appendix C** describes any significant changes made to the Site 300 ground water compliance monitoring program since the last report. **Appendix D** discusses Quality Assurance (QA).

Statistical Methods

Requirements for statistical analysis of ground water monitoring data are established in the California Code of Regulations (CCR), Title 23. The methods used for the statistical results reported herein are consistent with the 23 CCR. See **Appendix B** for a brief discussion of the statistical methodology used in this report.

The subtraction of background radioactivity from sample measurements can result in negative values for samples with low radioactivity levels. In accordance with U.S. Department of Energy guidance document DOE/EH-0173T, (U.S. DOE, 1991), these negative values are used in the statistical analyses.

As required by U.S. DOE Orders, we report radiological results in the *Système International* (SI) unit, Becquerel per liter (Bq/L). If desired, multiply Bq/L in **Appendix A** data tables by 27 to convert to picoCurie per liter (pCi/L). For additional

convenience, the primary drinking water Maximum Contaminant Levels (MCLs) for radiological parameters are given in both Bq/L and pCi/L in **Table 1**.

Table 1. Maximum Contaminant Levels for radiological parameters (provided in Bq/L and pCi/L)

Radiological Parameter	MCL (Bq/L)	MCL (pCi/L)
Gross alpha	0.555	15
Gross beta	1.85	50
Tritium	740	20,000
Radium-226 plus Radium-228	0.185	5
Total Uranium	0.74	20

Summary of Results

On June 15, water was detected dripping from the outlet of one of three leachate collection pipes installed between the inner and outer liners of the upper process-water surface impoundment in the HE Process Area. The flow, which goes directly to the lower surface impoundment, continues at a rate of about 15 liters/day (4 gallons/day). Analytical results from samples of the flow, flow location, and flow rate indicate that a small break exists in the high density polyethylene (HDPE) liner. LLNL is lowering the water level in the upper impoundment to locate the break and to repair the HDPE liner as necessary to stop the flow. The absence of water in lysimeters installed beneath the outer impermeable clay liner indicates that the flow is presently confined to the space between the inner and outer liners.

The following measurements of ground water samples taken during the second quarter of 1995 exceed Concentration Limits (CLs) for constituents of concern as specified in WDR 93-100 for Pits 1 and 7 (**Table B-1** in **Appendix B** lists constituents of concern. CLs are given in **Tables A-1** and **A-2** in **Appendix A**). Such data are considered "statistically significant evidence of a release" from the respective pit, and they bring about an investigation by LLNL to determine the source(s) of the constituent(s) in question. No evidence of a release from Pits 1 and 7 that has not been previously reported is indicated by the second quarter measurements.

 Pit 1. <u>Tritium</u> activity was above the 18.5 Bq/L CL in a ground water sample from well K1-02B (145 Bq/L). The tritium source is most likely the Building 850 firing table area, about one kilometer west-southwest of Pit 1.

- **Pit 7 Complex**. <u>Barium</u> concentration was above the 0.09 mg/L CL in ground water samples from wells K7-01 (0.16 mg/L) and NC7-48 (0.14 mg/L). Potential barium sources, including natural sources, are being investigated.
- **Pit 7 Complex.** <u>Vanadium</u> concentration was above the 0.05 mg/L CL in a ground water sample from well NC7-47 (0.062 mg/L). Potential vanadium sources, including natural sources, are being investigated.
- **Pit 7 Complex**. <u>Tritium</u> activity was above the 3 Bq/L CL in ground water samples taken from wells K7-01 (1188 Bq/L), K7-03 (6512 Bq/L), NC7-25 (10,175 Bq/L), NC7-26 (56 Bq/L), and NC7-48 (6 Bq/L). The tritium activities represent historical releases from Pits 3 and 5, adjacent to Pit 7.
- **Pit 7 Complex**. One or more <u>uranium</u> isotope activities were above their respective CLs in downgradient ground water samples from wells K7-01, K7-03, NC7-25, and NC7-48. Of note, for the first time the sample from upgradient well K7-06 exceeded CLs for all three uranium isotopes. Natural uranium has been identified by isotopic signature in ground water samples from wells K7-01, K7-03, and NC7-25. Since 1993, depleted uranium has been continuously identified in ground water samples from well NC7-48. Both Pit 7 and Pit 5 appear to have been sources of depleted uranium prior to the RCRA-capping of the Pit 7 landfill, completed in February 1993.

The following measurements exceed the Federal or California primary drinking water MCLs. Drinking water MCLs are used only for reference since the wells in these areas are not used as water sources.

- Pit 1. None.
- **Pit 7 Complex**. Tritium activities exceeded the 740 Bq/L MCL in ground water samples from wells K7-01 (1188 Bq/L), K7-03 (6512 Bq/L), and NC7-25 (10175 Bq/L). Tritium activity increased 1000 Bq/L (18%) since the first quarter in ground water samples from well K7-03. Since the first quarter, total uranium activity increased from 0.31 Bq/L to 0.85 Bq/L in the ground water sample from well NC7-48 and exceeded the 0.74 Bq/L MCL. Nitrate exceeded the 45 mg/L MCL in a ground water sample from well K7-01 (46 mg/L).

• **B-817 HE Process Area.** Ground water samples from wells W-817-01, -02, -03, and -04 exceeded the 50 μ g/L MCL for <u>arsenic</u> and the 45 mg/L MCL for <u>nitrate</u>. The ground water sample from well W-817-02 exceeded the 50 μ g/L MCL for <u>selenium</u>. Natural sources are indicated for arsenic and selenium. Potential nitrate sources, including natural sources, are being investigated. <u>Trichloroethene</u> (TCE) exceeded the 5 μ g/L MCL in ground water samples from wells W-817-03 (13 μ g/L), -03A (56 μ g/L), and -04 (6 μ g/L). The source of the TCE has been identified in the Building 815 area, about 0.1 km hydrologically upgradient (north) of the evaporation ponds.

Discussion of Monitoring Results

Pit 1 Area

Figure 2 shows the covered landfills Pits 1 and 2, the eight Pit 1 compliance monitoring wells (K1-01C, -02B, -03, -04, -05, -07, -08, -09), and the Advanced Test Accelerator (ATA). The Pit 1 monitoring wells are completed near or at the contact between the Tertiary Neroly Formation lower blue sandstone unit (Tnbs₁) and the deeper Mid-Miocene claystones and siltstones of the Cierbo Formation (Tmss). The Neroly and Cierbo formations contain the main water-bearing strata beneath Site 300. Ground water flows east-northeast beneath Pit 1, following the dip of the underlying

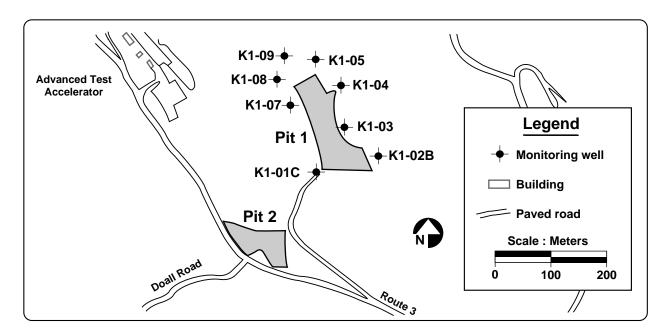


Figure 2. Location of Compliance Monitoring Wells in the Pit 1 Area

strata. As defined in WDR 93-100, wells K1-01C and K1-07 are hydrologically upgradient; wells K1-02B, -03, -04, and -05 are downgradient; and wells K1-08 and K1-09 are cross-gradient, relative to the RCRA-closed Pit 1 landfill.

Pit 1 Inspection Summary

The Post-Closure Plan (PCP) requires an inspection of Pit 1 once each quarter and after each major rain storm. A major storm is one that produces runoff for a period of at least 2 hours, or otherwise produces 4 inches of rainfall. One Pit 1 inspection was conducted by LLNL technical staff on May 16, 1995. Personnel noted that the Pit 1 cap was in good condition with no noticeable settlement or erosion. The diversion channels were free of debris, and the ground water monitoring network was in good working order.

Statistical and Analytical Results

Pit 1 ground water samples were analyzed for constituents fulfilling the requirements of WDR 93-100 and the PCP. Analyses consisted of metals; general minerals; the general parameters pH, specific conductance, total dissolved solids (TDS), total organic carbon (TOC), and total organic halides (TOX); energetic materials (HE compounds); general radioactivity (gross alpha and gross beta); and specific radioisotopes (thorium-228, -232, tritium, radium-226, and uranium-234, -235, and -238). Data for the Pit 1 ground water compliance monitoring wells are presented in **Table A-1, Appendix A**; Quality Assurance (QA) data from the duplicate and field blank samples can be found in **Table D-1, Appendix D**.

Results of first-quarter statistical analyses of the Pit 1 data are given in **Table B-2**, **Appendix B.** Significant statistical differences requiring discussion were found only for <u>tritium</u> in a ground water sample from well K1-02B. The tritium activity appears to represent the leading edge of a plume of tritium-bearing ground water that originated upgradient of Pit 1, about 1 kilometer to the west-southwest at the Building 850 firing table (Taffet and Wade, 1994, in Webster-Scholten, 1994).

Figure 3 is a graph of quarterly tritium activity in ground water samples taken from well K1-02B beginning with the second quarter of 1993. Tritium activity increased in ground water samples from this well beginning in 1989. The activity peaked at 130 Bq/L during the fourth quarter of 1993 and declined during the first two quarters of 1994. Subsequently, during the past year, tritium activity has steadily increased at a rate

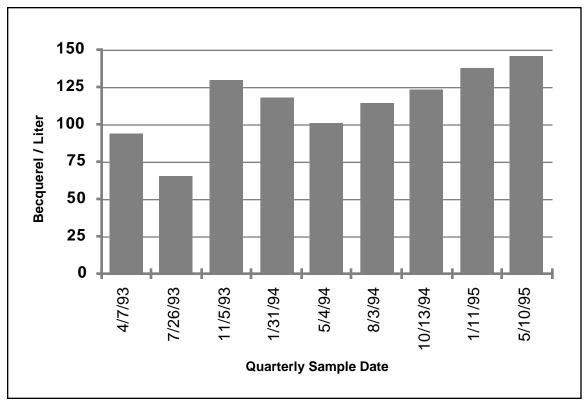


Figure 3. Quarterly Tritium Activity in Well K1-02B Ground Water Samples

of about 10 Bq/liter/quarter and reached 145 Bq/L during the second quarter of 1995. The second-quarter tritium activity in the ground water sample from well K1-02B is the maximum measured to date and is equal to 20% of the 740 Bq/L MCL for tritium in drinking water.

Pit 7 Complex Area

Figure 4 shows the covered landfills Pits 3, 4, 5, and 7, and the nine compliance monitoring wells (K7-01, -03, -06, -09, -10; and NC7-25, -26, -47, -48). Wells K7-01, K7-10, and NC7-26 are completed in the lower blue sandstone (Tnbs₁) of the Neroly Formation that immediately underlies much of the Pit 7 complex. The remaining wells are completed either at the base of the Neroly Formation, or within the deeper claystones and sandstones of the Cierbo Formation. Ground water flows east-northeast beneath the Pit 7 Complex Area, following the dip of the underlying sedimentary strata. As defined in WDR 93-100, monitoring well K7-06 is hydrologically upgradient of Pit 7, wells K7-09 and K7-10 are cross-gradient, and the remaining wells are downgradient.

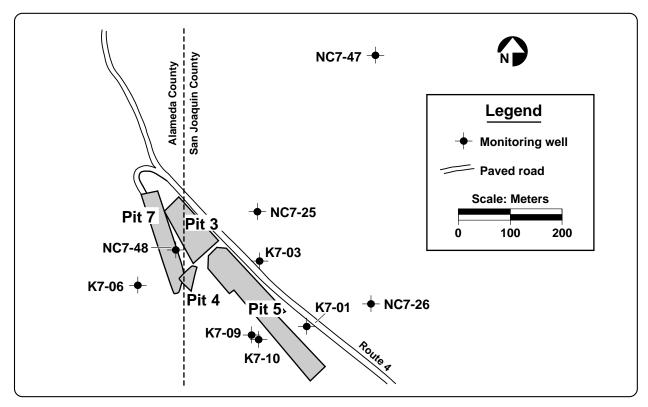


Figure 4. Location of Compliance Monitoring Wells in the Pit 7 Complex Area

Pit 7 Inspection Summary

The PCP requires an inspection of Pit 7 once a quarter and after each major rain storm. One inspection of Pit 7 was made by LLNL technical staff on May 16, 1995. Personnel noted that the Pit 7 cap was in good repair with no noticeable settlement or erosion. The diversion channels were free of debris, and the ground water compliance monitoring network was in good working order.

Statistical and Analytical Results

All Pit 7 ground water samples were analyzed for constituents fulfilling the requirements of WDR 93-100 and the PCP. Analyses consisted of metals; general minerals; the general parameters pH, specific conductance, TDS, TOC, and TOX; HE compounds; radioactivity (gross alpha and gross beta); specific radioisotopes (thorium-228, -232, tritium, radium-226, and uranium-234, -235, and -238); and volatile organic compounds (VOCs; EPA Method 601). Data for the Pit 7 Complex ground water monitoring wells are presented in **Table A-2**, **Appendix A.** QA data from the duplicate and field blank samples can be found in **Table D-2**, **Appendix D**.

Results of statistical analyses of the Pit 7 data are given in **Table B-3**, **Appendix B**. Significant statistical differences requiring discussion were found between upgradient well K7-06 and other monitoring wells in the network as follows:

- 1. Significant differences in barium, wells K7-01 and NC7-48.
- 2. Significant differences in nitrate, well K7-01.
- 3. Significant differences in vanadium, well NC7-47.
- 4. Significant differences in tritium, wells K7-01, -03, NC7-25, -26, and -48.
- 5. Significant differences in uranium isotopes, wells K7-01, -03, NC7-25, and -48.

<u>Barium</u> continued to be measured above the CL in ground water samples from monitoring wells K7-01 and NC7-48. Historical measurements of barium above the CL in ground water samples from well K7-01 extend from the first measurements made in 1984 to the present. Statistically significant evidence of a release of barium from Pit 7 to the ground water was reported to the CVRWQCB in a letter dated November 9, 1993. An investigation of potential barium sources, including natural sources, is continuing.

<u>Nitrate</u> exceeded the 45 mg/L MCL in a ground water sample from well K7-01 (46 mg/L). Nitrate reached the MCL in the farthest downgradient monitoring well NC7-47.

<u>Vanadium</u> continued to be measured above the 0.05 μ g/L CL in ground water samples from well NC7-47 (0.062 μ g/L). Statistical evidence of a release of vanadium from Pit 7 was initially reported to the CVRWQCB in a letter dated June 3, 1994. An investigation of potential vanadium sources, including natural sources, is continuing.

Second quarter tritium activities continued above the 740 Bq/L MCL for drinking water in ground water samples from downgradient monitoring wells K7-01 (1188 Bq/L), K7-03 (6512 Bq/L), and NC7-25 (10175 Bq/L). Tritium activities in ground water samples from these wells and from wells NC7-26 (56 Bq/L), and NC7-48 (6 Bq/L) were above the 3 Bq/L concentration limit (CL) established by WDR 93-100. The tritium activities have been linked to sources in Pits 3 and 5, adjacent to and hydrologically downgradient from Pit 7 (Taffet and Wade, 1994, in Webster-Scholten, 1994). As a result of new reporting requirements called for in WDR 93-100, statistical evidence of a release of tritium from closed Pits 3 and 5 in the Pit 7 Complex was reported to the CVRWQCB in a letter dated November 9, 1993.

<u>Uranium</u> isotope activities were above their respective CLs in samples from monitoring wells K7-01, K7-03, NC7-25, and NC7-48. Surprisingly, the ground water sample from upgradient monitoring well K7-06 contained activities above CLs for the three uranium isotopes measured. As indicated by isotopic signature, natural uranium is the source of the uranium activity in ground water samples from wells K7-01, K7-03, and NC7-25. Mass spectroscopy has revealed a depleted uranium isotopic signature in

ground water samples from well NC7-48. Statistically significant evidence of a release of uranium from Pit 7 was initially reported to the CVRWQCB in a letter dated September 10, 1993.

Figure 5 shows quarterly measurements of uranium-238 activity in ground water samples from well NC7-48 since the second quarter of 1993. Uranium-238 activity had been decreasing in a roughly exponential manner since May 1993. Although a large increase in activity was measured in the second quarter 1995 sample and is apparent in the graph, the value is well within the historical range of measurements.

Because CLs for several constituents of concern, as specified in WDR 93-100, were exceeded, LLNL established an evaluation monitoring and assessment program in 1994 for the Pit 7 area and the Pit 1 area. The purpose of the program is to determine the nature and extent of barium, lead, tritium, uranium isotopes, and vanadium adjacent to Pit 7 and arsenic adjacent to Pit 1 by sampling ground water from additional wells and conducting additional chemical analyses.

This work is being transferred from RCRA compliance to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) compliance. Ground water monitoring data will be integrated into this effort. If LLNL confirms that

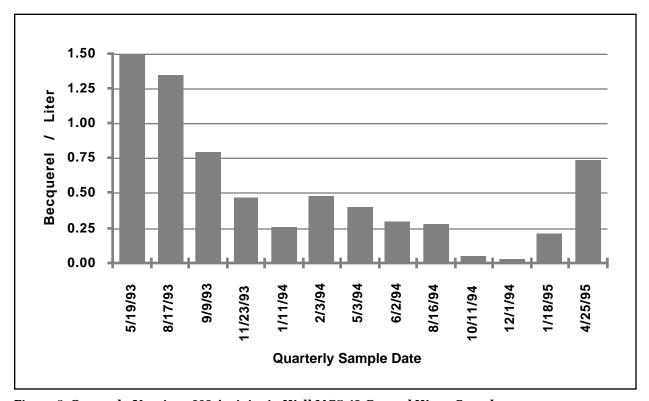


Figure 5. Quarterly Uranium-238 Activity in Well NC7-48 Ground Water Samples

hazardous substances are or were released from Pits 1 and 7 to ground water, chemical specific fate and transport analysis and a risk assessment will be conducted. If these assessments indicate that the risks or hazards posed by these substances are significant, as defined by CERCLA, corrective actions for the appropriate landfill(s) will be incorporated into the CERCLA process. Results of this work will be transmitted to the CERCLA Remedial Project Managers (RPMs).

A uranium characterization for the Pit 7 Complex area (Pits 3, 4, 5, and 7) has recently been completed. The uranium characterization included ground water sampling and analysis for uranium and uranium isotopes, additional sampling and uranium analysis of soil and rock, fate and transport modeling, and a risk assessment. The full results of this study are due to the CERCLA RPMs by February 15, 1996.

VOC analyses of ground water samples from Pit 7 compliance monitoring wells are required by the PCP. Several organic compounds have been historically detected at levels near or above primary drinking water MCLs. <u>Trichloroethene</u> (TCE) was measured below the 5 μ g/L MCL in ground water samples from two downgradient monitoring wells, K7-01 (2.7 μ g/L) and K7-03 (2.6 μ g/L). The TCE breakdown product, <u>1,1-dichloroethene</u> (1,1-DCE), was measured below the 6 μ g/L MCL in the same samples from wells K7-01 (0.6 μ g/L) and K7-03 (0.6 μ g/L). The source of the TCE has been determined to be Pit 5, which is adjacent to and hydrologically downgradient of Pit 7 (Taffet and Wade, 1994, in Webster-Scholten, 1994).

B-817 HE Process Area

Compliance monitoring of the two Class II process-water surface impoundments is called for in permit WDR 85-188 (CVRWQCB, 1985). **Figure 6** shows the two impoundments, their five compliance monitoring ground water wells, and Buildings 815 (B-815) and 817 (B-817). Ground water samples are taken quarterly from these monitoring wells for analysis. Four of the compliance monitoring wells are completed in the Neroly upper blue sandstone, a water-bearing formation. A fifth well, W-817-03A, is completed at shallow depth in a non-marine formation, consisting of unconsolidated sediments and sedimentary rocks, that locally overlies the Neroly Formation. This overlying formation contains a perched water-bearing zone that is restricted both laterally and vertically. The direction of water flow in both zones is approximately southeast and follows the local slope, or dip, of the formations. As defined in WDR 85-188, well W-817-01 is hydrologically upgradient of the impoundments, and wells W-817-02, -03, -03A, and -04 are downgradient.

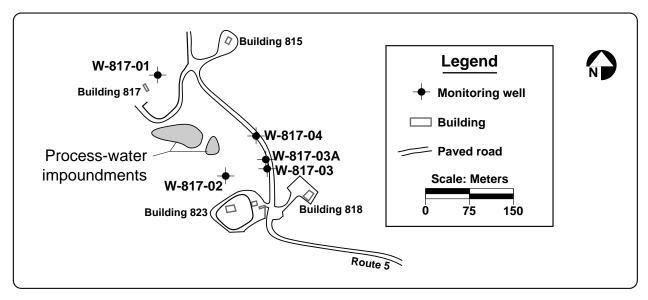


Figure 6. Location of Compliance Monitoring Wells in the B-817 HE Process Area

Weekly visual inspection of a shallow, gravity-fed, leachate collection system for the presence of water is called for in WDR 85-188. The leachate collection system consists of perforated pipes installed between the inner HDPE liner and the outer impermeable clay liner of each impoundment. Any water collected by the system beneath the upper impoundment flows directly into the lower (smaller) impoundment and can be easily viewed. Water collected by the system beneath the lower impoundment flows into a tank in a vault constructed on the east side of the lower impoundment. These gravity-fed leachate collection systems provide for early visual detection should a leak occur in the inner HDPE liner of either impoundment.

As additionally called for in WDR 85-188, an attempt is made once per quarter to withdraw water from seven buried lysimeters connected to the surface by copper tubing. The lysimeters are installed in the vadose zone immediately beneath the doubly-lined impoundments. Four lysimeters are installed in a filled trench beneath the upper impoundment, and three lysimeters are installed in a similar trench beneath the lower impoundment. The lysimeters were initially tested and found to be operational in 1988. Subsequently, no water has been obtained during routine quarterly operation of the lysimeters. Two of the four lysimeters beneath the upper impoundment are functional. The tubing to one lysimeter is blocked, rendering it inoperable. Another lysimeter will not hold a vacuum. It is probably cracked or crushed. However, the close proximity of the four lysimeters to each other in a single, filled trench is a highly redundant system. A single functional lysimeter should be adequate to detect leachate

from the upper impoundment if it breaches the outer impermeable clay liner. All three lysimeters installed beneath the lower impoundment are functional.

As required by permit WDR 85-188, the leachate collection systems installed beneath both the upper and lower process-water impoundments were inspected weekly during the second quarter for the presence of water. On June 15, a small flow of water was detected dripping from one of three perforated pipes that comprise the leachate collection system for the upper impoundment. Most of the process water effluents were immediately diverted from the upper to the lower impoundment. Samples were taken for analyses called for in WDR 85-188 on June 16, 19, 22, and 30. Many additional potential constituents were analyzed. The results of these analyses is given in **Table A-4, Appendix A.** No constituent measured in the samples was above an MCL.

On June 29, LLNL staff reported orally to the CVRWQCB regarding the flow and our sampling activities. Subsequently, LLNL took steps to accelerate evaporation to reduce process water in the upper impoundment so that the source of the flow can be located and repaired. On June 30, an air sparging system was temporarily installed in the upper impoundment to reduce the water level. As of August 9, 1995, the water level was 23 cm (9 in) above the sand layer. Sludge sampling will determine the methodology to be employed by LLNL to locate the suspected leak and to repair the HDPE liner. Either dry (vacuum) methods, or wet (electrical conductivity) methods can be used to locate leaks in the HDPE liner. The water level must be lowered to perform either of these diagnostic methods.

As required by permit WDR 85-188, an attempt was made to withdraw water from the lysimeters installed beneath the B-817 process-water impoundments. No water was detected.

Ground water samples were collected from the five compliance monitoring wells in the B-817 HE Process Area. As required by WDR 85-188, these samples were analyzed for metals, minerals, TOC, TOX, pH, specific conductance, HE compounds (RDX, HMX, and TNT), and VOCs (EPA Method 601). Due to the difficulty of obtaining sufficient sample volume, ground water from well W-817-03A is analyzed only for VOCs and HE compounds. Ground water monitoring data for the B-817 HE Process Area are presented in **Table A-3**, **Appendix A**; QA data from the duplicate and field blank samples can be found in **Table D-3**, **Appendix D**.

Statistical and Analytical Results

Statistical results involving analyses of measurements of ground water samples taken from the monitoring well network in the B-817 HE Process area are given in

Table B-4, Appendix B. Confirming the lysimeter results, the well water sample data do not indicate that leachate from the surface impoundments has reached the underlying ground water. Specifically, the measured leachate shows considerable HMX, but no RDX, while the ground water samples show the reverse (**Tables A-3** and **A-4** in **Appendix A**).

Ground water samples from the monitoring well network (upgradient and downgradient wells) continued to show high concentrations of <u>arsenic</u>, <u>selenium</u>, and <u>nitrate</u>, near or above drinking water MCLs. The MCL for arsenic is 50 μ g/L; for selenium, 50 μ g/L; and for nitrate, 45 mg/L. The highest concentrations measured during the second quarter of 1995 were as follows: 64 μ g/L for arsenic in well W-817-04; 52 μ g/L for selenium in well W-817-02; and 88 mg/L for nitrate in wells W-817-03 and W-817-04 (**Table A-3** in **Appendix A**). Arsenic and selenium in the ground water are believed to result from dissolution of arsenopyrite and mafic minerals found naturally in the volcaniclastic Neroly upper sandstone (Webster-Scholten, 1994; Raber and Carpenter, 1983). The sources of the elevated nitrates in the ground water samples are uncertain. An investigation of possible nitrate sources, including natural sources, is continuing.

<u>TCE</u> continued to be detected at concentrations above its 5 μg/L MCL in ground water samples from downgradient monitoring wells W-817-03 (13 μg/L), W-817-03A (56 μg/L), and W-817-04 (6 μg/L). 1,2-dichloroethene (1,2-DCE) continued to be detected at a concentration of 3 μg/L in a water sample from well W-817-03A. The VOCs in these water samples taken from the B-817 HE Process Area compliance monitoring well network do not represent releases from the process-water impoundments. Rather, they are due to identified TCE sources that are hydrologically upgradient of the impoundments in the vicinity of B-815 (**Figure 6**; Landgraf, 1994, in Webster-Scholten, 1994).

Although TCE has increased for the past two quarters in ground water samples taken from well W-817-03A, the long term trend is decreasing (**Figure 7**). The graph places the recent TCE increase in perspective and suggests a similarity to temporary concentration increases that have occurred several times in the past.

Consistent with previous quarters, the HE compound \underline{RDX} was most concentrated in the ground water sample from upgradient well W-817-01. The measured concentration was $100\mu g/L$. RDX was detected near the 5 $\mu g/L$ detection limit at 5.9 $\mu g/L$ in the ground water sample from downgradient well W-817-03. The HE compound \underline{HMX} was not detected above its 5 $\mu g/L$ detection limit in any ground water

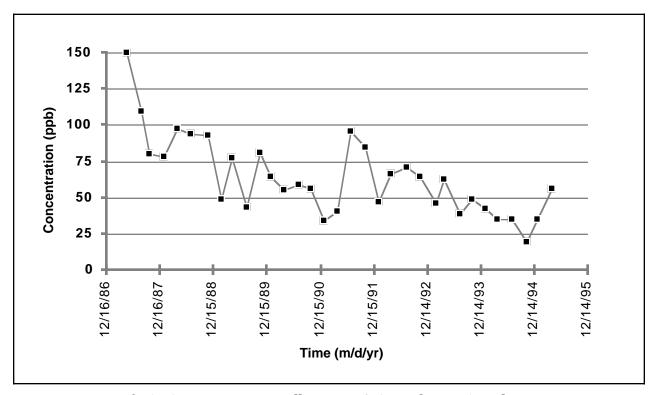


Figure 7. History of TCE Concentration in Well W-817-03A Ground Water Samples

sample from this monitoring network. No Federal or California state MCLs have been set for these HE compounds. The HE detections are consistent with HE sources that are hydrologically upgradient from the process-water impoundments (Landgraf, 1994, in Webster-Scholten, 1994).

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Acknowledgments

The Site 300 ground water monitoring program could not be conducted without the dedicated efforts of many people. The field technical team, led by Dave Graves, was responsible for timely and accurate sample collection and analysis requisition. Becky Goodrich coordinated the field activities. Contract laboratory support was provided by California Laboratory Services, GTEL Environmental Laboratories, Inc., Lockheed Environmental Systems & Technologies Co., and Quanterra Environmental Services. Tritium analyses were performed at LLNL by Ann Ruth. Don MacQueen provided the statistical analyses and associated tables. Suzie Chamberlain compiled the data tables. Grace Massa provided much needed administrative assistance. We thank Milt Grissom, Leo Gross, Jim Lane, Dan Knight, and Dan Rodriguez at Site 300 for their cooperation in this effort. Many editorial comments from additional LLNL reviewers were helpful and have been incorporated.

List of Abbreviations and Acronyms

1,1-DCE 1,1-dichloroethene 1,2-DCE 1,2-dichloroethene

ATA Advanced Test Accelerator

B-817 Building 817

CAL/EPA California Environmental Protection Agency

CCR California Code of Regulations

CERCLA Comprehensive Environmental Response,

Compensation, and Liability Act

CL Concentration Limit

CVRWQCB Central Valley Regional Water Quality

Control Board

DHS Department of Health Services (California)

DOE US Department of Energy

DTSC Department of Toxic Substances Control

EMP Environmental Monitoring Plan EPA Environmental Protection Agency FFA Federal Facility Agreement

HE High Explosive

HDPE High Density Polyethylene

HMX Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine

(also cyclo-tetramethylene-tetranitramine)

HPLC High Pressure Liquid Chromatography
LLNL Lawrence Livermore National Laboratory

MCL Maximum Contaminant Level

PCP Post-Closure Plan
PL Prediction limit
QA Quality Assurance
QAP Quality Assurance Plan

RCRA Resource Conservation and Recovery Act RDX Hexahydro-1,3,5-trinitro-1,3,5-triazine

(also cyclo-1,3,5-trimethylene 2,4,6-

trinitramine)

RPM Remedial Project Manager

TCE Trichloroethene (trichloroethylene)

TDS Total Dissolved Solids

TNT 2-methyl-1,3,5-trinitrobenzene

(also trinitrotoluene)

TOC Total Organic Carbon
TOX Total Organic Halides
VOC Volatile Organic Compound

WDR Waste Discharge Requirements (permit)

Appendix A

Ground Water Monitoring Data

Table A-1. Second quarter ground water analytical results, Pit 1 Area

Dates sampled: 5/10/95 and 5/11/95.

Location								
Parameter	K1-01C	K1-02B	K1-03	K1-04	K1-05	K1-07	K1-08	K1-09
General								
pH (units)	7.3	7.4	7.4	7.5	7.6	7.4	7.5	7.6
Specific Conductance (µmhos/cm)	490.	600.	470.	490.	490.	480.	500.	500.
Total dissolved solids (mg/L)	430.	430.	340.	360.	350.	350.	370.	360.
Water Table Elevation (ft)	970.6	968.6	966.8	963.2	957.1	966.1	966.3	963.7
Water Temperature (Celsius)	21.5	20.3	21.5	21.	22.3	19.8	20.5	21.1
Metals and Minerals (mg/L)	21.0	20.0	21.0	21.	22.0	13.0	20.0	21.1
Bicarbonate Alk (as CaCO<)	- 150.	140.	150.	150.	130.	130.	130.	130.
Total Alkalinity (as CaCO<)	150.	140.	150.	150.	130.	130.	130.	130.
Aluminum	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	0.014	0.013	0.015	0.012	0.014	0.014	0.015	
Arsenic (CL=0.02)	< 0.014	< 0.013	< 0.015	< 0.012	0.014	< 0.014	0.015	0.014 0.033
Barium (CL=0.05)	< 0.025	< 0.025	< 0.025	< 0.025	< 0.0005	< 0.025	< 0.0005	< 0.0005
Beryllium (CL=0.0005)								
Cadmium (CL=0.0005)	< 0.0005 46.	< 0.0005 54.	< 0.0005 44.	< 0.0005	< 0.0005 37.	< 0.0005	< 0.0005 40.	< 0.0005
Calcium Chloride	46. 34.	54. 54.	33.	45. 31.	37. 34.	38. 31.	40. 35.	39. 36.
Chromium	0.0019	0.0013	< 0.001	0.0024	< 0.001	< 0.001	0.0024	0.0013
	< 0.0019	< 0.0013	< 0.001	< 0.0024	< 0.001	< 0.001	< 0.0024	< 0.0013
Cobalt (CL to be determined)	0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
Copper (CL=0.07) Fluoride	0.065	0.03	0.03	0.03	0.03	0.05	0.55	0.54
Total Hardness (as CaCO<)	190.	230.	180.	180.	170.	160.	170.	170.
Iron	< 0.1 < 0.002	< 0.1 < 0.002						
Lead (CL=0.009)	18.	23.	17.	17.	18.	17.	18.	18.
Magnesium	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Manganese Mercury	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0002
Nickel (CL=0.10)	< 0.0002	< 0.0002	< 0.0002	< 0.1	< 0.0002	< 0.0002	< 0.0002	< 0.0002
	26.	27.	22.	18.	30.	28.	29.	29.
Nitrate (as NO<) Potassium	26. 3.5	3.	22. 2.9	3.3	30. 2.8	26. 2.9	3.2	29. 2.9
Selenium	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Silver	0.002	0.002	0.002	0.0002	0.002	< 0.002	< 0.002	< 0.002
Sodium	33.	40.	32.	38.	39.	39.	< 0.0005 40.	< 0.0005 40.
Sulfate	33. 44.	40. 75.	43.	53.	39. 47.	39. 44.	4 0. 50.	40. 54.
Surfactant	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Thallium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Vanadium (CL=0.09)	0.065	0.056	0.053	0.036	0.072	0.073	0.064	0.065
Zinc (CL=0.06)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Energetic Materials (μg/L)	< 0.00	V 0.00	\ 0.00	< 0.00	< 0.00	< 0.00	< 0.00	< 0.00
HMX (CL=26)	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.
RDX (CL=30)	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.
TNT	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.
Radioactivity (Bq/L)			. •					
Gross alpha (CL=0.555)	0.367	0.047	0.090	0.122	0.051	0.162	0.092	0.052
Gross beta (CL=1.85)	0.223	0.013	0.106	0.140	0.125	0.151	0.122	0.076
Radioisotopes (Bq/L)								
Radium 226 (CL=0.037)	0.0052	0.0014	0.0030	0.0037	0.0059	0.0052	0.0044	0.0036
Thorium 228 (CL to be determined)		-0.0003	-0.0006	-0.0009	0.0004	0.0022	-0.0003	-0.0001
Thorium 232 (CL to be determined)		0.0011	-0.0001	0.0012	-0.0001	0.0017	0.0008	-0.0001
Tritium (CL=18.5)	11.2	145	8.9	0.5	0.4	-0.4	-0.5	-0.7
Uranium 234 (CL=0.230)	0.182	0.073	0.046	0.056	0.041	0.069	0.029	0.047
Uranium 235 (CL=0.007)	0.001	0.003	0.004	0.001	0.001	-0.001	0.001	0.000
Uranium 238 (CL=0.102)	0.108	0.026	0.036	0.021	0.029	0.015	0.015	0.036
Uranium, total (MCL=0.74)	0.291	0.102	0.086	0.078	0.071	0.083	0.045	0.083

Table A-2. Second quarter ground water analytical results, Pit 7 Complex Area

Dates sampled: 4/25/95 - 5/3/95.

Dates sampled: 4/25/95 - 5/5/95.	Location								
Parameters	K7-01	K7-03	K7-06	K7-09	K7-10	NC7-25	NC7-26	NC7-47	NC7-48
General		7	7.0	0.4	7.0	7.4	7.0	77	6.7
pH (units) Specific Conductance (μmhos/cm)	6.5 550.	7. 610.	7.2 370.	8.4 670.	7.3 810.	7.1 760.	7.3 560.	7.7 520.	6.7 760.
Total dissolved solids (mg/L)	450.	450.	290.	480.	680.	550.	430.	390.	590.
Water Table Elevation (ft)	1296.4	1315.9	1391.2	1297.7	1307.9	1299.6	1257.9	1205.4	1351.6
Water Temperature (Celsius)	20.9	21.4	22.4	18.4	19.2	19.7	19.1	18.3	20.3
water remperature (Geisius)	20.5	21.4	22.7	10.4	13.2	13.7	13.1	10.5	20.5
Metals and Minerals (mg/L)	_								
Bicarbonate Alk (as CaCO<)	210.	200.	130.	130.	160.	280.	160.	130.	340.
Total Alkalinity (as CaCO<)	210.	200.	130.	130.	160.	280.	160.	130.	340.
Aluminum	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Arsenic (CL to be determined)	0.009	0.0022	0.0045	< 0.002	0.0027	< 0.002	0.0021	0.014	0.0075
Barium (CL=0.09)	0.16	0.068	0.047	< 0.025	0.059	0.038	< 0.025	0.047	0.14
Beryllium (CL=0.0005)	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Cadmium (CL to be determined)	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Calcium	59.	71.	42.	45.	110.	64.	63.	41.	98.
Chloride	39.	42.	24.	18.	16.	76.	29.	48.	62.
Chromium	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.0033
Cobalt (CL to be determined)	< 0.05	< 0.025	< 0.05	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.05
Copper (CL to be determined) Fluoride	< 0.05 0.48	0.058 0.33	< 0.05 0.45	< 0.05 0.17	< 0.05 0.18	< 0.05 0.67	< 0.05 0.3	< 0.05 0.6	< 0.05 0.29
Total Hardness (as CaCO<)	250.	260.	160.	190.	430.	290.	240.	170.	330.
Iron	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Lead (CL=0.002)	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Magnesium	25.	21.	13.	18.	34.	31.	20.	17.	21.
Manganese	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mercury	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Nickel (CL to be determined)	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Nitrate (as NO<)	46.	27.	11.	< 0.5	< 0.5	30.	< 0.5	45.	20.
Potassium	2.1	3.5	2.1	31.	6.3	2.6	3.5	4.2	4.2
Selenium	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Silver	0.0081	0.0052	0.0019	0.0029	0.0058	0.0043	0.0014	0.0014	0.013
Sodium	42.	34.	32.	66.	31.	78.	33.	46.	68.
Sulfate	27.	41.	35.	220.	320.	49.	110.	33.	47.
Surfactant	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Thallium	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Vanadium (CL=0.05)	< 0.05	< 0.025	< 0.05	< 0.025	< 0.025	< 0.05	< 0.025	0.062	< 0.05
Zinc (CL to be determined)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
EPA Method 601 (μg/L)	_								
1,1,1-Trichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1,2,2-Tetrachloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1,2-Trichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1-Dichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1-Dichloroethene	0.58	0.56	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,2-Dichlorobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,2-Dichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,2-Dichloroethene (total)	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,2-Dichloropropane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,3-Dichlorobenzene 1,4-Dichlorobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
	< 0.5	< 0.5 < 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
2-Chloroethylvinylether Bromodichloromethane	< 0.5 < 0.5	< 0.5	< 0.5 < 0.5	< 0.5 < 0.5	< 0.5 < 0.5	< 0.5 < 0.5	< 0.5 < 0.5	< 0.5 < 0.5	< 0.5 < 0.5
Bromoform	< 0.5	< 0.5	< 0.5 < 0.5	< 0.5	< 0.5	< 0.5	< 0.5 < 0.5	< 0.5 < 0.5	< 0.5
Bromomethane	< 0.5	< 0.5	< 0.5 < 0.5	< 0.5	< 0.5	< 0.5	< 0.5 < 0.5	< 0.5 < 0.5	< 0.5
Carbon tetrachloride	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chlorobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chloroform	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chloromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5

Table A-2. Second quarter ground water analytical results, Pit 7 Complex Area (Continued)

Dates sampled: 4/25/95 - 5/3/95.

·	Location								
Parameters	K7-01	K7-03	K7-06	K7-09	K7-10	NC7-25	NC7-26	NC7-47	NC7-48
cis-1,3-Dichloropropene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Dibromochloromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Dichlorodifluoromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Freon 113	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Methylene chloride	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Tetrachloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
trans-1,3-Dichloropropene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Trichloroethene	2.7	2.6	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Trichlorofluoromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.9
Vinyl chloride	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Energetic Materials (μg/L)		_	_	_	_	_		_	_
HMX	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.
RDX	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.
TNT	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.	< 5.
Radioactivity (Bq/L)									
Gross alpha	0.279	0.182	0.001	0.069	0.034	0.470	0.047	0.117	1.300
Gross beta	0.161	0.185	-0.016	0.733	0.201	0.320	0.091	0.167	0.681
Radioisotopes (Bq/L)									
Radium 226 (CL to be determined)	-0.0011	0.0104	0.0031	0.0056	0.0074	0.0067	0.0130	0.0041	-0.0011
Thorium 228 (CL to be determined)	0.0001	0.0003	-0.0011	0.0001	-0.0012	-0.0011	-0.0008	-0.0011	0.0007
Thorium 232 (CL to be determined)	0.0011	-0.0001	0.0022	0.0007	0.0014	0.0000	-0.0001	0.0007	0.0052
Tritium (CL=3.17)	1188	6512	-0.63	2.23	2.40	10175	55.5	-0.42	6.14
Uranium 234 (CL=0.078)	0.176	0.069	0.165	0.007	0.013	0.084	0.010	-0.233	0.211
Uranium 235 (CL=0.0037)	0.011	0.006	0.013	-0.0001	0.0003	0.007	0.001	0.000	0.010
Uranium 238 (CL=0.059)	0.199	0.083	0.120	0.005	0.003	0.077	0.003	-0.033	0.633
Uranium, total (MCL=0.74 Bq/L)	0.386	0.158	0.298	0.0119	0.0163	0.168	0.014	-0.266	0.854

Table A-3. Second quarter ground water analytical results, B-817 HE Process Area

Dates sampled: 4/12/95 and 4/14/95 plus additional arsenic sampling on 4/19/95, 4/28/95, and 5/5/95.

			Location		
Parameter	W-817-01	W-817-02	W-817-03	W-817-03A	W-817-04
General					_
pH (units)	7.8	7.7	7.8		7.8
Specific Conductance (µmhos/cm	n) 1,100.	1,940.	1,510.		1,500.
Total Organic Carbon (mg/L)	< 1.	< 1.	< 1.		5.
Total Organic Halides (mg/L)	0.03	0.16	0.15		0.24
Total Dissolved Solids (mg/L)	810.	1,400.	1,000.		1,100.
Water Temperature (Celsius)	24.	21.1	20.1	16.3	22.4
Metals and Minerals (mg/L)					
Bicarbonate Alk (as CaCO<)	240.	250.	250.		250.
Total Alkalinity (as CaCO<)	240.	250.	250.		250.
Aluminum	< 0.2	< 0.2	< 0.2		< 0.2
Antimony	0.012	0.0056	0.0085		< 0.005
Arsenic (MCL=0.050)	0.045	0.049	0.048		0.047
	0.051	0.050	0.049		0.064
	0.043	0.050	0.050		0.055
	0.049	0.058	0.056		0.061
Barium	< 0.025	< 0.025	< 0.025		< 0.025
Beryllium	< 0.0005	< 0.0005	< 0.0005		< 0.0005
Cadmium	0.00051	< 0.0005	< 0.0005		< 0.0005
Calcium	14.	36.	20.		19.
Chloride	160.	330.	220.		240.
Chromium	0.0017	0.0015	0.0031		0.0032
Cobalt	< 0.025	< 0.025	< 0.025		< 0.025
Copper	< 0.05	< 0.05	< 0.05		< 0.05
Fluoride	0.9	1.	1.2		1.2
Total Hardness (as CaCO<)	57.	160.	95.		83.
Iron	< 0.1	< 0.1	< 0.1		< 0.1
Lead	< 0.002	< 0.002	< 0.002		< 0.002
Magnesium	5.3	16.	11.		8.6
Manganese	< 0.03	< 0.03	< 0.03		< 0.03
Mercury	< 0.0002	< 0.0002	< 0.0002		< 0.0002
Molybdenum	< 0.025	< 0.025	< 0.025		0.036
Nickel	< 0.1	< 0.1	< 0.1		< 0.1
Nitrate (MCL = 45 as NO<)	76 .	85.	88.		88.
Potassium	9.5	14.	11.		11.
Selenium (MCL = 0.050)	0.033	0.052	0.022		0.022
Silver	< 0.0005	< 0.0005	0.0012		< 0.0005
Sodium	270.	410.	330.		340.
Sulfate	120.	380.	210.		230.
Surfactant	< 0.5	< 0.5	< 0.5		< 0.5
Thallium	< 0.005	< 0.005	< 0.005		< 0.005
Vanadium	0.13	0.13	0.13		0.11
Zinc	< 0.05	< 0.05	< 0.05		< 0.05

Table A-3. Second quarter ground water analytical results, B-817 HE Process Area (Continued)

Dates sampled: 4/12/95 and 4/14/95 plus additional arsenic sampling on 4/19/95, 4/28/95, and 5/5/95.

	Location					
Parameter	W-817-01	W-817-02	W-817-03	W-817-03A	W-817-04	
Phenolics (mg/L)					 -	
Phenolics	 < 0.03	< 0.03	< 0.03		< 0.03	
EPA Method 601 (μg/L)						
1,1,1-Trichloroethane	_ < 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
1,1,2,2-Tetrachloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
1,1,2-Trichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
1,1-Dichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
1,1-Dichloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
1,2-Dichlorobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
1,2-Dichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
1,2-Dichloroethene (total)	< 0.5	< 0.5	< 0.5	3.	< 0.5	
1,2-Dichloropropane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
1,3-Dichlorobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
1,4-Dichlorobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
2-Chloroethylvinylether	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Bromodichloromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Bromoform	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Bromomethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Carbon tetrachloride	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Chlorobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Chloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Chloroform	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Chloromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
cis-1,3-Dichloropropene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Dibromochloromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Dichlorodifluoromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Freon 113	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Methylene chloride	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Tetrachloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
trans-1,3-Dichloropropene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Trichloroethene	< 0.5	< 0.5	13.	56.	6.2	
Trichlorofluoromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Vinyl chloride	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Energetic Materials (μg/L)	=					
HMX	< 5.	< 5.	< 5.	< 5.	< 5.	
RDX	100.	< 5.	5.9	< 5.	< 5.	
TNT	< 5.	< 5.	< 5.	< 5.	< 5.	

Table A-4. Analyses of Water from Upper Pond Leachate Collection System

Sample Number >	1	2	3	4
Sample Date >	6/16/95	6/19/95	6/22/95	6/30/95
Parameter				
General				
pH (units) *	8.4	8.2	7.6; 7.7	7.6
Conductance (µmhos/cm) *	5880	5670	5830; 4900	4400
TDS (mg/L)	2960	2840	2870; 3400	3100
Metals (mg/L)				
Antimony	<0.01	< 0.01	n.a.	< 0.005
Arsenic	0.0086	0.0062	n.a.	0.046
Barium	0.09	0.058	n.a.	0.075
Beryllium	0.00065	0.00055	n.a.	< 0.0005
Cadmium	< 0.0005	< 0.0005	n.a.	< 0.0005
Chromium	0.0072	0.0035	n.a.	0.002
Cobalt	< 0.05	< 0.05	n.a.	< 0.025
Lead	0.0064	< 0.002	n.a.	< 0.002
Mercury	< 0.0002	< 0.0002	n.a.	< 0.0002
Molybdenum	< 0.05	< 0.05	n.a.	< 0.025
Selenium	< 0.002	< 0.002	n.a.	< 0.002
Silver	0.003	0.0011	n.a.	< 0.0005
Thallium	< 0.01	0.0054	n.a.	< 0.004
Vanadium	<0.05	< 0.05	n.a.	<0.025
Energetic Materials (μg/L)				
HMX*	55	21	n.a.	n.a.
RDX*	<20	<20	n.a.	n.a.
TNT	<20	<20	n.a.	n.a.
General Minerals (mg/L)				
Total Alkalinity	n.a.	n.a.	860	820
Bicarbonate Alkalinity	n.a.	n.a.	860	820
Aluminium	1.2	<0.2	<0.2	<0.2
Calcium	n.a.	n.a.	210	190
Chloride	n.a.	n.a.	740	710
Copper	0.013	0.005	< 0.05	0.0041
Fluoride	n.a.	n.a.	0.22	0.22
Hardness	n.a.	n.a.	1000	910
Iron	n.a.	n.a.	<0.1	<0.1
Magnesium	n.a.	n.a.	120	100
Manganese	0.04	< 0.023	< 0.03	< 0.03
Nickel	0.03	0.025	<0.1	0.023
Nitrate	n.a.	n.a.	24	24
Potassium	13	10	10	8.6
Sodium	n.a.	n.a.	900	760
Sulfate	n.a.	n.a.	800	890
Surfactant	n.a.	n.a.	< 0.05	< 0.05
Zinc	< 0.02	< 0.02	< 0.02	< 0.02
* analysis required by WDD 8	E 100			

^{*} analysis required by WDR 85-188

n.a. = not analyzed

Appendix B

Statistical Analyses

Appendix B

Statistical Analyses

Table B-1 identifies the constituents of concern and monitoring parameters for which statistical analyses are required. A check ($\sqrt{}$) in Table B-1 indicates that statistical analysis is required. A dash (–) indicates that statistical analysis is not required. "TBD" (to be determined) indicates that background values and concentration limits for those constituents had not been determined for lack of sufficient data when WDR 93-100 was issued. Background data for such constituents have now been collected; we anticipate that concentration limits for these constitutents will be incorporated in a future amendment to WDR 93-100. "Proposed" indicates that statistical analysis is not currently required. LLNL anticipates that the proposed constituents will be included in a future WDR for the B-817 HE Process Area.

Tables B-2, B-3, and B-4 identify downgradient well samples whose mean or median concentration is statistically different from upgradient well samples for a particular listed parameter, or that had a measurement that exceeded the concentration limit (CL) for the listed constituent of concern. "None" means either that none of the downgradient or cross-gradient well sample means or medians show a statistically significant difference for the listed parameter when compared with the upgradient well samples, or that none of the sample measurements exceeded the CL. "TBD" indicates that background values and concentration limits are "to be determined." "All" means either that the water samples from all of the downgradient and crossgradient wells show statistically significant differences for a listed parameter, or that all the well sample measurements exceeded the CL for the listed constituent of concern.

The Post-Closure Plan (PCP) requires that statistical methods be approved by the U.S. Environmental Protection Agency (EPA). WDR No. 85-188 requires that statistical methods be from the California Administrative Code, Title 23, Chapter 3, Subchapter 15. WDR No. 93-100 requires that the statistical methods be from the California Code of Regulations (CCR), Title 23, Division 3, Chapter 15, Section 2550.7. The methods in CCR Title 23 are consistent with current EPA guidance and are used for all statistical analyses reported herein.

We perform either a prediction interval or control chart method for the indicator parameters specified in WDR 93-100 and WDR 85-188. Both methods are listed in CCR

Title 23, Chapter 15, Section 2550.7. We use a prediction interval method for all other constituents of concern. These methods requires one sample measurement of each constituent of concern from each well in the monitoring network.

Prediction intervals test for a difference between upgradient and downgradient concentrations. Control charts test for a change in concentration at a well, relative to the concentration history at that well. Prediction intervals are appropriate when there is no appreciable spatial variation in the vicinity of the unit being monitored. Control charts are appropriate when there is spatial variation.

Prediction intervals use upgradient data to determine an upper bound value against which to compare individual downgradient sample results. The upper bound, called the prediction limit (PL), is selected so that future individual sample results have approximately a 1-in-100 chance of being above the PL, when there is no difference in the distributions of upgradient and downgradient concentrations. This gives a statistical test with a significance level of approximately 0.01.

Parametric prediction intervals are used when all of the upgradient data are above the detection limit and the data are approximately normally distributed. Nonparametric prediction intervals are used when the data are not normally distributed or when there are non-detections. Parametric prediction interval methods may be used on log-transformed data, if such a transformation causes the data to follow a normal distribution.

Control charts use previous history at each downgradient well to determine a background value and upper bound value for that well. The upper bound, called the control limit, is selected so that future individual sample results have approximately a 1-in-100 chance of being above the control limit, when there has been no change in the distribution of concentrations. This gives a statistical test with a significance level of approximately 0.01.

Table B-1. Constituents of Concern and Areas Monitored

Constituent	Pit 1 Area	Pit 7 Area	B-817 HE Process Area
TDS	√	V	_
Specific Conductance	√	√	V
рН	√	V	√
TOC	√ (PCP)		√
TOX	√ (PCP)		V
Arsenic		TBD	Proposed
Barium	√	V	_
Beryllium	√	V	_
Cadmium	√	TBD	_
Cobalt	TBD	TBD	_
Copper	√	TBD	_
Lead	√	V	_
Nickel	√	TBD	_
Silver	_	_	Proposed
Vanadium	√	V	_
Zinc	√	TBD	-
Radium 226	V	TBD	
Tritium	√ √	√ V	_
U233,234	V	V	_
U235,236	V	V	_
U238	√	V	_
Thorium 228	TBD	TBD	_
Thorium 232	TBD	TBD	-
HMX	\ \ \	TBD	Proposed
RDX	√ √	TBD	Proposed
TNT		-	Proposed
PETN	_	_	Proposed
Nitrate (as NO3)	_	_	Proposed
Acetone	_	_	Proposed
MEK	_	_	Proposed
Phenols	_		Proposed

Table B-2. Constituents and Statistically Significant Pit 1 Wells

Constituent	Pit 1 Area
TDS	None
Specific Conductance	None
рН	None
Arsenic	None
Barium	None
Beryllium	None
Cadmium	None
Cobalt	TBD
Copper	None
Lead	None
Nickel	None
Vanadium	None
Zinc	None
Radium 226	None
Tritium	K1-02B
U233,234	None
U235,236	None
U238	None
Thorium 228	TBD
Thorium 232	TBD
HMX	None
RDX	None

Table B-3. Constituents and Statistically Significant Pit 7 Wells

Constituent	Pit 7 Area
TDS	None
Specific	
Conductance	None
pН	None
Arsenic	TBD
Barium	K7-01, NC7-48
Beryllium	None
Cadmium	None
Cobalt	None
Copper	None
Lead	None
Nickel	None
Vanadium	NC7-47
Zinc	None
Radium 226	None
Tritium	K7-01, K7-03, NC7-26, NC7-48
U233,234	K7-01, NC7-25, NC7-48
U235,236	K7-01, K7-03, NC7-25, NC7-48
U238	K7-01, K7-03, NC7-25, NC7-48
Thorium 228	None
Thorium 232	None
HMX	TBD
RDX	TBD

Table B-4. Constituents and Statistically Significant B-817 HE Process Area Wells

Constituent	B-817 HE Process Area
Specific	
Conductance	None
pН	None
TOC	None
TOX	None

Appendix C

Changes in Programs or Methods

Appendix C

Changes in Programs or Methods

This appendix describes changes made to the monitoring program since the previous quarter.

No changes were made to the sampling plan regarding constituents of concern, sampling methods, sample tracking procedures, analytical methods, or data management. Different statistical methods, either control charts or prediction limits, were employed this quarter on general indicator parameters and some additional constituents of concern (see **Appendix B** for discussion).

Appendix D

Quality Assurance Program

Appendix D

Quality Assurance Program

Discussion of the Quality Assurance (QA) Program

To assure data quality, LLNL utilizes an extensive written set of protocols and procedures that covers all aspects of ground water sampling, sample tracking, and environmental data management. The set of written instructions forms the Quality Assurance Plan (QAP) and the Environmental Monitoring Plan (EMP). Included is the training of LLNL technical staff in appropriate sampling techniques. Following these protocols prevents inadvertent sample contamination and maintains sample integrity from the sampling location to the analytical laboratory. Data management procedures assure that all laboratory measurements are received and are accurately recorded and stored in a computer database as well as in hardcopy form. In addition, as part of the QA program, the data quality of each quarter's sampling activity is assessed by the following methods.

A duplicate sample is collected from a randomly chosen well for each of the three monitoring networks reported herein (Pit 1, Pit 7, and the B-817 HE Process Area). Identical analyses are performed on the routine and duplicate samples, and the results are compared. If a substantial difference exists between the routine and duplicate measurements, the discrepancy is investigated.

For laboratory comparison purposes, the routine second quarter QA samples were sent to California Laboratory Services, and the duplicate QA samples were sent to GTEL for analysis. Problems encountered were minor. Different limits were reported by the two laboratories for non-detections and several duplicate analyses were not completed. These included nickel and nitrate for the Pits 1 and 7 duplicates; dichlorofluoromethane for the Pit 7 duplicate; and copper, nickel, nitrate, silver, and zinc for the HE Process Area duplicate.

Field blanks, prepared for each of the three monitoring networks, use hydrogenpurged, deionized water for the tests for purgeable organic compounds. Blanks use High Pressure Liquid Chromatography (HPLC)-grade water for all other required analyses. Field blanks, prepared at well locations chosen at random, are analyzed for the identical parameters as those outlined for each network's routine wells. Field blank data are reviewed to ensure that contamination has not occurred as a result of field handling procedure or laboratory processing.

Equipment blanks are prepared and analyzed quarterly to provide a routine assessment of equipment decontamination and maintenance practices.

Discussion of Quality Assurance Results

Pit 1. The measurements of constituents of concern were comparable between the routine and duplicate samples for well K1-09 within the uncertainties inherent in the various methods used. Tritium activity in the field blank is indicative of the source area for the blank water.

Pit 7. The measurements of constituents of concern were comparable between the routine and duplicate samples for well K7-01 within the uncertainties inherent in the various methods used. More uranium-235 activity was reported for the field blank than for the routine and duplicate samples. We have previously shown that the alpha spectroscopy method gives elevated and highly variable results at these low levels when compared to the mass spectroscopy method for uranium-235. This low-level measurement problem may exist for thorium-228, also reported to be higher in the field blank than in the routine and duplicate samples. LLNL has requested the analytical laboratory to repeat the thorium measurement of the Pit 7 field blank.

B-817 HE Process Area. The measurements of constituents of concern were comparable between the routine and duplicate samples for well W-817-03 within the uncertainties inherent in the various methods used, except for Total Organic Carbon (TOC) and Total Organic Halides (TOX). The large differences reported for TOC and TOX by the two laboratories illustrate the large uncertainties inherent in these rather crude measurements.

Table D-1. Routine, Duplicate, and Field Blank Analyses, Pit 1 Area

Dates sampled: 5/10/95 and 5/11/95.

Rarameter K1-09 Routine K1-09 Duplicate PIT1 Field Blank General pH (units) 7.6 8.2 5.6 Specific Conductance (µmhos/cm) 500. 620. 2.0 Total Dissolved Solids (mg/L) 360. 350. < 1.				
Ceneral PH (units) 7.6 8.2 5.6 5.6 5.5 5.6 5.5 5.6		K1-09		
pH (units)	Parameter	Routine	Duplicate	Field Blank
pH (units)				
Specific Conductance (umhos/cm) 500. 620. 2.0 Total Dissolved Solids (mg/L) 360. 350. < 1.		7.0	0.0	5 0
Total Dissolved Solids (mg/L) 360. 350. < 1. Metals and Minerals (mg/L) Varsenic 0.014 0.017 < 0.002 Barium 0.033 0.035 < 0.025	. ,			
Metals and Minerals (mg/L) Arsenic 0.014 0.017 < 0.002 Barium 0.033 0.035 < 0.025				
Arsenic 0.014 0.017 < 0.0025 Barium 0.033 0.035 < 0.025	Total Dissolved Solids (Hig/L)	300.	330.	< 1.
Barium	Metals and Minerals (mg/L)			
Beryllium	Arsenic	0.014	0.017	< 0.002
Cadmium < 0.0005	Barium	0.033	0.035	< 0.025
Calcium 39. 42. < 0.5	•			
Chloride 36. 40. < 0.5				
Chromium 0.0013 < 0.01				
Cobalt < 0.025 < 0.01 < 0.025 Copper < 0.05				
Copper < 0.05 < 0.01 < 0.05 Total Hardness (as CaCO·) 170. 180. < 1.				
Total Hardness (as CaCO c) 170.				
Iron < 0.1	• •			
Lead				
Magnesium			-	
Manganese				
Mercury	•		-	
Nickel	•			
Nitrate (as NO·) 29.			< 0.0002 *	
Potassium 2.9			*	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$				
Silver				
Sodium				
Sulfate 54. 51. < 1.				
Surfactant < 0.5				
Thallium $< 0.001 < 0.005 < 0.001$ Vanadium $0.065 > 0.071 < 0.025$ Zinc $< 0.05 < 0.02 < 0.05$ Energetic Materials (μg/L) HMX $< 5. < 5. < 5. < 5.$ RDX $< 5. < 5. < 5.$ TNT $< 5. < 5. < 5. < 5.$ TNT $< 5. < 5. < 5.$ Radioactivity (Bq/L) Gross alpha $0.052 \pm 0.014 > 0.041 \pm 0.063 > 0.016 \pm 0.005$ Gross beta $0.076 \pm 0.011 > 0.181 \pm 0.078 > 0.005 \pm 0.011$ Radioisotopes (Bq/L) Radioisotopes (Bq/L) Radium 226 $0.0036 \pm 0.0005 > 0.0126 \pm 0.0089 > 0.0022 \pm 0.0044$ Thorium 228 $0.0036 \pm 0.0015 > 0.0078 \pm 0.0070 > 0.0008 \pm 0.0004$ Thorium 232 $0.0001 \pm 0.0001 > 0.0028 \pm 0.0030 > 0.0023 \pm 0.0028$ Tritium $0.0001 \pm 0.0001 > 0.0028 \pm 0.0030 > 0.0023 \pm 0.0028$ Tritium $0.0001 \pm 0.0001 > 0.0028 \pm 0.0030 > 0.0023 \pm 0.0028$ Tritium $0.0001 \pm 0.0001 > 0.0038 \pm 0.0030 > 0.0023 \pm 0.0028$ Tritium $0.0001 \pm 0.0001 > 0.0038 \pm 0.0030 > 0.0023 \pm 0.0028$ Tritium $0.0001 \pm 0.0001 > 0.0038 \pm 0.0030 > 0.0023 \pm 0.0028$ Tritium $0.0001 \pm 0.0001 > 0.0038 \pm 0.0030 > 0.0023 \pm 0.0028$ Tritium $0.0001 \pm 0.0001 > 0.0038 \pm 0.0030 > 0.0023 \pm 0.0028$ Tritium $0.0001 \pm 0.0001 > 0.0038 \pm 0.0030 > 0.0023 \pm 0.0028$ Tritium $0.0001 \pm 0.0001 > 0.0038 \pm 0.0030 > 0.0024 \pm 0.0041$ Uranium 234 $0.00474 \pm 0.0163 > 0.0385 \pm 0.0100 > 0.0044 \pm 0.0041$ Uranium 235 $0.0000 \pm 0.0000 > 0.0010 \pm 0.0018 > 0.0000 \pm 0.0000$				
Vanadium 0.065 0.071 < 0.025 Zinc < 0.05 < 0.02 < 0.05 Energetic Materials (μg/L) Secondary (Bq/L) Secondary (Bq/L) HMX < 5. < 5. < 5. < 5. RDX < 5. < 5. < 5. < 5. < 5. TNT < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5. < 5.				
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Radioactivity (Bq/L)Gross alpha 0.052 ± 0.014 0.041 ± 0.063 0.016 ± 0.005 Gross beta 0.076 ± 0.011 0.181 ± 0.078 0.005 ± 0.011 Radioisotopes (Bq/L) $Radium 226$ 0.0036 ± 0.0005 0.0126 ± 0.0089 0.0022 ± 0.0004 Thorium 228 -0.0001 ± 0.0015 0.0078 ± 0.0070 -0.0008 ± 0.0004 Thorium 232 -0.0001 ± 0.0001 0.0028 ± 0.0030 0.0023 ± 0.0028 Tritium -0.7 ± 1.5 -0.6 ± 1.5 4.1 ± 2.0 Uranium 234 0.0474 ± 0.0163 0.0385 ± 0.0100 0.0044 ± 0.0041 Uranium 235 0.0000 ± 0.0000 0.0010 ± 0.0018 0.0000 ± 0.0000				
Gross alpha $0.052 \pm 0.014 0.041 \pm 0.063 0.016 \pm 0.005$ Gross beta $0.076 \pm 0.011 0.181 \pm 0.078 0.005 \pm 0.011$ Radioisotopes (Bq/L) Radium 226 $0.0036 \pm 0.0005 0.0126 \pm 0.0089 0.0022 \pm 0.0004$ Thorium 228 $-0.0001 \pm 0.0015 0.0078 \pm 0.0070 -0.0008 \pm 0.0004$ Thorium 232 $-0.0001 \pm 0.0001 0.0028 \pm 0.0030 0.0023 \pm 0.0028$ Tritium $-0.7 \pm 1.5 -0.6 \pm 1.5 4.1 \pm 2.0$ Uranium 234 $0.0474 \pm 0.0163 0.0385 \pm 0.0100 0.0044 \pm 0.0041$ Uranium 235 $0.0000 \pm 0.0000 0.0010 \pm 0.0018 0.0000 \pm 0.0000$				
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$\begin{array}{llllllllllllllllllllllllllllllllllll$				
$\begin{array}{llllllllllllllllllllllllllllllllllll$	Gross beta	0.076 ± 0.011	0.181 ± 0.078	0.005 ± 0.011
$\begin{array}{llllllllllllllllllllllllllllllllllll$	Radioisotopes (Bq/L)			
$\begin{array}{llllllllllllllllllllllllllllllllllll$		0.0036 ± 0.0005	0.0126 ± 0.0089	0.0022 ± 0.0004
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Uranium 234 0.0474 ± 0.0163 0.0385 ± 0.0100 0.0044 ± 0.0041 Uranium 235 0.0000 ± 0.0000 0.0010 ± 0.0018 0.0000 ± 0.0000	Thorium 232			
Uranium 235 $0.0000 \pm 0.0000 0.0010 \pm 0.0018 0.0000 \pm 0.0000$	Tritium	-0.7 ± 1.5	-0.6 ± 1.5	4.1 ± 2.0
		0.0474 ± 0.0163	0.0385 ± 0.0100	0.0044 ± 0.0041
Uranium 238 0.0355 ± 0.0137 0.0300 ± 0.0089 0.0009 ± 0.0019	Uranium 235			
* analysis not done		0.0355 ± 0.0137	0.0300 ± 0.0089	0.0009 ± 0.0019

^{*} analysis not done

Table D-2. Routine, Duplicate, and Field Blank Analyses, Pit 7 Complex Area

Dates sampled: 4/25/95 - 5/3/95.

_	K7-01	K7-01	PIT7
Parameter	Routine	Duplicate	Field Blank
General			
pH (units)	6.5	7.4	4.9
Specific Conductance	550.	680.	2.0
(μmhos/cm)			
Total Dissolved Solids (mg/L)	450.	430.	< 1.
Metals and Minerals (mg/L)			
Arsenic	0.009	0.009	< 0.002
Barium	0.16	0.19	< 0.025
Beryllium	< 0.0005	< 0.005	< 0.0005
Cadmium	< 0.0005	< 0.005	< 0.0005
Calcium	59.	60.	< 0.5
Chloride	39.	40.	< 0.5
Chromium	0.002	< 0.01	< 0.001
Cobalt	< 0.05	< 0.01	< 0.05
Copper	< 0.05	0.017	< 0.05
Total Hardness (as CaCO<)	250.	240.	< 1.
Iron	< 0.1	< 0.1	< 0.1
Lead	< 0.002	< 0.005	< 0.002
Magnesium	25.	25.	< 0.5
Manganese	< 0.03	0.006	< 0.03
Mercury	< 0.0002	< 0.0002	< 0.0002
Nickel	< 0.1	*	< 0.1
Nitrate (as NO<)	46.	*	< 0.5
Potassium	2.1	2.1	< 0.5 < 1.
Selenium	< 0.002	< 0.005	< 0.002
Silver			< 0.002 < 0.0005
Sodium	0.0081 42.	< 0.01 41.	< 0.0005 < 1.
Sulfate	42. 27.	41. 29.	< 1. < 1.
Surfactant	< 0.5	< 0.1	< 0.5
Thallium	< 0.005	< 0.005	< 0.005
Vanadium	< 0.05	0.023	< 0.05
Zinc	< 0.05	< 0.02	< 0.05
EPA Method 601 (μg/L)			
1,1,1-Trichloroethane	< 0.5	< 0.5	< 0.5
1,1,2,2-Tetrachloroethane	< 0.5	< 0.5	< 0.5
1,1,2-Trichloroethane	< 0.5	< 0.5	< 0.5
1,1-Dichloroethane	< 0.5	< 0.5	< 0.5
1,1-Dichloroethene	0.58	< 0.5	< 0.5
1,2-Dichlorobenzene	< 0.5	< 0.5	< 0.5
1,2-Dichloroethane	< 0.5	< 0.5	< 0.5
1,2-Dichloroethene (total)	< 0.5	*	< 0.5
1,2-Dichloropropane	< 0.5	< 0.5	< 0.5
1,3-Dichlorobenzene	< 0.5	< 0.5	< 0.5
1,4-Dichlorobenzene	< 0.5	< 0.5	< 0.5
2-Chloroethylvinylether	< 0.5	< 1.	< 0.5
Bromodichloromethane	< 0.5	< 0.5	< 0.5
2. chicalonio officinario	- 0.0	` 0.0	. 0.0

Table D-2. Routine, Duplicate, and Field Blank Analyses, Pit 7 Complex Area (Continued)

Dates sampled: 4/25/95 - 5/3/95.

		15- 24	
_	K7-01	K7-01	PIT7
Parameter	Routine	Duplicate	Field Blank
Bromoform	< 0.5	< 0.5	< 0.5
Bromomethane	< 0.5	< 0.5	< 0.5
Carbon tetrachloride	< 0.5	< 0.5	< 0.5
Chlorobenzene	< 0.5	< 0.5	< 0.5
Chloroethane	< 0.5	< 0.5	< 0.5
Chloroform	< 0.5	< 0.5	< 0.5
Chloromethane	< 0.5	< 0.5	< 0.5
cis-1,3-Dichloropropene	< 0.5	< 0.5	< 0.5
Dibromochloromethane	< 0.5	< 0.5	< 0.5
Dichlorodifluoromethane	< 0.5	*	< 0.5
Freon 113	< 0.5	< 0.5	< 0.5
Methylene chloride	< 0.5	< 0.5	< 0.5
Tetrachloroethene	< 0.5	< 0.5	< 0.5
trans-1,3-Dichloropropene	< 0.5	< 0.5	< 0.5
Trichloroethene	2.7	3.1	< 0.5
Trichlorofluoromethane	< 0.5	< 0.5	< 0.5
Vinyl chloride	< 0.5	< 1.	< 0.5
Energetic Materials (μg/L)			
HMX " " ,	< 5.	< 5.	< 5.
RDX	< 5.	< 5.	< 5.
TNT	< 5.	< 5.	< 5.
Radioisotopes (Bq/L)			
Radium 226	-0.001 ± 0.003	0.018 ± 0.009	0.000 ± 0.001
Thorium 228	0.000 ± 0.004	0.004 ± 0.007	0.020 ± 0.011
Thorium 232	0.001 ± 0.004	0.003 ± 0.003	0.003 ± 0.004
Tritium	1188 ± 12	1132 ± 56	3.8 ± 2.0
Uranium 234	0.272 ± 0.063	0.202 ± 0.027	0.047 ± 0.013
Uranium 235	0.017 ± 0.008	0.024 ± 0.009	0.053 ± 0.004
Uranium 238	0.245 ± 0.057	0.027 ± 0.005 0.179 ± 0.025	0.042 ± 0.012
* analysis not done	3.2.0 = 3.007	30 = 3.020	0.0.2 = 0.012

^{*} analysis not done

Table D-3. Routine, Duplicate, and Field Blank Analyses, B-817 HE Process Area

Dates sampled: 4/12/95 and 4/14/95 (plus additional arsenic on 4/19, 4/28, and 5/5/95)

	W-817-03	W-817-03	817
Parameter	Routine	Duplicate	Field Blank
General			
pH (units)	7.8	7.9	6.0
Specific Conductance (µmhos/cm)	7.0 1510	7.9 1800	2
Total Organic Carbon (mg/L)	< 1	9	3
Total Organic Carbon (mg/L) Total Organic Halides (mg/L)	0.15	0.012	< 0.02
Total Dissolved Solids (mg/L)	1,000.	1,100.	< 1.
Total Dissolved Solids (Hig/L)	1,000.	1,100.	\ 1.
Metals and Minerals (mg/L)			
Antimony	0.0085	< 0.05	< 0.005
Arsenic	0.048	0.051	< 0.002
	0.049	0.052	< 0.002
	0.05	0.05	< 0.002
	0.056	0.078	< 0.002
Barium	< 0.025	0.006	< 0.025
Beryllium	< 0.0005	< 0.005	< 0.0005
Cadmium	< 0.0005	< 0.005	< 0.0005
Calcium	20.	18.	< 0.5
Chloride	220.	200.	< 0.5
Chromium	0.0031	< 0.01	< 0.001
Cobalt	< 0.025	< 0.01	< 0.025
Copper	< 0.05	*	< 0.05
Total Hardness (as CaCO<)	95.	94.	< 1.
Iron	< 0.1	< 0.1	< 0.1
Lead	< 0.002	< 0.005	< 0.002
Magnesium	11.	9.1	< 0.5
Manganese	< 0.03	< 0.005	< 0.03
Mercury	< 0.0002	< 0.0002	< 0.0002
Molybdenum	< 0.025	0.035	< 0.025
Nickel	< 0.1	*	< 0.1
Nitrate (as NO<)	88.	*	< 0.5
Potassium	11.	9.6	< 1.
Selenium	0.022	0.037	< 0.002
Silver	0.0012	*	< 0.0005
Sodium	330.	360.	< 1.
Sulfate	210.	140.	< 1.
Thallium	< 0.005	< 0.005	< 0.005
Vanadium	0.13	0.13	< 0.025
Zinc	< 0.05	*	< 0.05
Phenolics (mg/L)			
Phenolics	< 0.03	0.02	< 0.03

Table D-3. Routine, Duplicate, and Field Blank Analyses, B-817 HE Process Area (Continued)

Dates sampled: 4/12/95 and 4/14/95 (plus additional arsenic on 4/19, 4/28, and 5/5/95)

	W-817-03	W-817-03	817
Parameter	Routine	Duplicate	Field Blank
		·	
EPA Method 601 (μg/L)			
1,1,1-Trichloroethane	< 0.5	< 0.4	< 0.5
1,1,2,2-Tetrachloroethane	< 0.5	< 0.4	< 0.5
1,1,2-Trichloroethane	< 0.5	< 0.4	< 0.5
1,1-Dichloroethane	< 0.5	< 0.4	< 0.5
1,1-Dichloroethene	< 0.5	< 0.4	< 0.5
1,2-Dichlorobenzene	< 0.5	< 0.8	< 0.5
1,2-Dichloroethane	< 0.5	< 0.4	< 0.5
1,2-Dichloropropane	< 0.5	< 0.4	< 0.5
1,3-Dichlorobenzene	< 0.5	< 0.8	< 0.5
1,4-Dichlorobenzene	< 0.5	< 0.8	< 0.5
2-Chloroethylvinylether	< 0.5	< 1.	< 0.5
Bromodichloromethane	< 0.5	< 0.4	< 0.5
Bromoform	< 0.5	< 1.2	< 0.5
Bromomethane	< 0.5	< 1.2	< 0.5
Carbon tetrachloride	< 0.5	< 0.4	< 0.5
Chlorobenzene	< 0.5	< 0.4	< 0.5
Chloroethane	< 0.5	< 0.8	< 0.5
Chloroform	< 0.5	< 0.4	< 0.5
Chloromethane	< 0.5	< 2.	< 0.5
cis-1,3-Dichloropropene	< 0.5	< 0.4	< 0.5
Dibromochloromethane	< 0.5	< 0.4	< 0.5
Dichlorodifluoromethane	< 0.5	< 5.	< 0.5
Methylene chloride	< 0.5	< 0.8	< 0.5
Tetrachloroethene	< 0.5	< 0.4	< 0.5
trans-1,3-Dichloropropene	< 0.5	< 0.4	< 0.5
Trichloroethene	13.	17.	< 0.5
Trichlorofluoromethane	< 0.5	< 0.4	< 0.5
Vinyl chloride	< 0.5	< 0.8	< 0.5
Energetic Materials (μg/L)			
HMX	< 5.	< 5.	< 5.
RDX	5.9	6.2	< 5.
TNT	< 5.	< 5.	< 5.

^{*} analysis not done

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